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DOE FUNDAMENTALS

MECHANICAL SCIENCE



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ABSTRACT

The Mechanical Science Handbook was developed to assist nuclear facility operating contractors in providing operators, maintenance personnel, and the technical staff with the necessary fundamentals training to ensure a basic understanding of mechanical components and mechanical science. The handbook includes information on diesel engines, heat exchangers, pumps, valves, and miscellaneous mechanical components. This information will provide personnel with a foundation for understanding the construction and operation of mechanical components that are associated with various DOE nuclear facility operations and maintenance.

Key Words: Training Material, Diesel Engine, Heat Exchangers, Pumps, Valves

MECHANICAL SCIENCE OVERVIEW

Department of Energy Fundamentals: *Mechanical Science* was prepared as an information resource for personnel who are responsible for the operation of the Department's nuclear facilities. Almost all processes that take place in the nuclear facilities involve the use of mechanical equipment and components. A basic understanding of mechanical science is necessary for DOE nuclear facility operators, maintenance personnel, and the technical staff to safely operate and maintain the facility and facility support systems. The information in this book is presented to provide a foundation for applying engineering concepts to the job. This knowledge will help personnel more fully understand the impact that their actions may have on the safe and reliable operation of facility components and systems.

Mechanical Science consists of five modules. The following is a brief description of the information presented in each module.

Module 1 - Diesel Engine Fundamentals

Provides information covering the basic operating principles of 2-cycle and 4-cycle diesel engines. Includes operation of engine governors, fuel ejectors, and typical engine protective features.

Module 2 - Heat Exchangers

Describes the construction of plate heat exchangers and tube and shell heat exchangers. Describes the flow patterns and temperature profiles in parallel flow, counter flow, and cross flow heat exchangers.

Module 3 - Pumps

Explains the operation of centrifugal and positive displacement pumps. Topics include net positive suction head, cavitation, gas binding, and pump characteristic curves.

Module 4 - Valves

Introduces the functions of the basic parts common to most types of valves. Provides information on applications of many types of valves. Types of valves covered include gate valves, globe valves, ball valves, plug valves, diaphragm valves, reducing valves, pinch valves, butterfly valves, needle valves, check valves, and safety/relief valves.

Module 5 - Miscellaneous Mechanical Components

Provides information on significant mechanical devices that have widespread application in nuclear facilities but do not fit into the categories of components covered by the other modules. These include cooling towers, air compressors, demineralizers, filters, strainers, etc.

The information contained in this handbook is not all-encompassing. An attempt to present the entire subject of mechanical science would be impractical. However, *Mechanical Science* presents enough information to provide the reader with the fundamental knowledge necessary to understand the advanced theoretical concepts presented in other subject areas, and to understand basic system and equipment operation.